The volatile iron carbonyl has been made the subject of a number of similar observations, dealing with its physical properties and chemical stability, which will be discussed in another communication.

"An Enquiry into the Variation of Angles observed in Crystals, especially of Potassium-Alum and Ammonium-Alum." By Professor H. A Miers, M.A., D.Sc., F.R.S. Received March 10,—Read March 26, 1903.

(Abstract.)

Corresponding angles measured on different crystals of the same substance usually differ slightly. On cubic crystals the theoretical angles are known. Pfaff professed to have established that only those cubic crystals which display birefringence exhibit divergence from the theoretical angles, but Brauns showed that in lead nitrate, ammonia-alum, and spinel, for both isotropic and birefringent crystals alike, the octahedron angle may differ by as much as 20′ from that of the regular octahedron.

The author has endeavoured to trace the changes of angle upon one and the same crystal during its growth by measuring it at intervals without moving it from the solution in which it is growing. This is accomplished by means of a new telescope-goniometer in which the crystal is observed through one side of a rectangular glass trough, and the changes in the inclination of each face are followed by watching the displacements of the image of a collimator slit viewed by reflection in it. The crystal is held by a platinum clip which it envelopes as it grows. Small movements of the image are followed by means of a special micrometer-eyepiece which accurately measures the magnitude and direction of the displacement.

Examined in this way an octahedron of alum (ammonium or potassium) is found to yield not one but three images from each face; and closer inspection shows that the crystal is not really an octahedron, but has the form of a very flat triakis octahedron. It often happens that of the three faces which nearly coincide, one is large and the remaining two very small, so that of the three images one is bright and the others are very faint, and can only be discerned with difficulty; in such a case the crystal as measured in the ordinary way would appear to be an octahedron whose angle differs from the theoretical value by a few minutes.

When a growing crystal of alum is watched for several hours or days, it is found that the three images yielded by an apparent octahedron face continually change their position; one set fades away and is replaced by another set, which are generally more widely

separated than those which they succeed. The images move in three directions inclined at 120° to each other, and indicate that these faces always belong to triakis octahedra. The point in which the lines of movement intersect within the field of view of the telescope would, therefore, be the position of the image reflected from the true octahedron face. Measured in this way the octahedron angle of alum is found to be the theoretical angle 70° $31\frac{3}{4}'$.

The images do not move continuously, but *per saltum*, indicating that the reflecting planes are vicinal faces which probably possess rational indices, and must, therefore, be inclined at certain definite angles to the octahedron face; but the indices are very high numbers.

Observations upon sodium chlorate, zinc sulphate, magnesium sulphate, and other substances, show that other crystals exhibit the same behaviour. The faces of a crystal are in general not faces with simple indices, but vicinal planes slightly inclined to them, and they change their inclinations during the growth of the crystal; they also change their inclinations when the crystal is immersed to a greater or less depth in the solution.

Every point within a crystal has at some time been a point on the surface, and has been subject to the conditions of equilibrium between crystal and solution which prevail there. It is believed by the author that a study of the vicinal planes and of the liquid in contact with them, may lead to some understanding of these conditions.

In order to ascertain the composition of the liquid, attempts were made to determine its refractive index by means of total reflection within the crystal. This appears, indeed, to be the only method which can give direct information concerning the ultimate layer in contact with the growing face, and it is somewhat remarkable that it has not been applied before. Considerable difficulty was experienced in making this measurement, but ultimately good readings were obtained, which gave the value 1·34428 as the refractive index in sodium light, at 19° C., of the liquid in contact with a growing crystal of alum. The refractive indices of a series of solutions of known strength, ranging from dilute to supersaturated, having been previously measured, the above index was found to correspond to a liquid containing about 10·80 grammes of alum in 100 grammes of solution. A saturated solution at 19° C. was found to have the refractive index 1·34250, and to contain about 9·01 grammes of alum in 100 grammes of solution.

Sodium chlorate was examined in the same way; it was found that the liquid in contact with a growing crystal has at 19° C. the index 1·38734, and contains about 47·8 grammes of salt in 100 grammes of solution; a saturated solution of sodium chlorate at 19° C. has the index 1·38649, and contains about 47·2 grammes of salt in 100 grammes of solution.

The liquid in contact with a growing crystal of sodium nitrate has at 19° C. the index 1·38991, and contains about 48·45 grammes of salt in 100 grammes of solution; a saturated solution at 19° C. has the index 1·38905, and contains about 48·1 grammes of salt in 100 grammes of solution.

In each case the liquid in contact with the growing crystal is slightly supersaturated. It was not found to exhibit double refraction even in the case of sodium nitrate. No experiments seem to have previously been made upon the nature of this liquid.

G. Wulff has suggested that vicinal faces are due to concentration streams in the solution. In order to test this view, crystals of alum were measured after growing for several hours in solution kept continually agitated in order to eliminate the action of the concentration streams. Almost no effect was produced upon the angles of the vicinal faces.

In sodium chlorate and sodium nitrate the solute is about 45 times more dense in the crystal than in the adjacent liquid. Now planes with high indices in a space-lattice contain fewer points in unit area than planes with simple indices. The author suggests that vicinal faces grow upon a crystal in preference to simple forms because the crystallising material descends upon the growing face in a shower which is not very dense.

"On the Dependence of the Refractive Index of Gases on Temperature." By GEORGE W. WALKER, M.A., Fellow of Trinity College, Cambridge. Communicated by Professor J. J. THOMSON, F.R.S. Received February 26,—Read March 26, 1903.

(Abstract.)

The investigations of Professor Mascart on this subject are perhaps the most extensive of any up to the present time. He examined the effect in several gases, and found that in general the temperature coefficient exceeded the theoretical coefficient given by Gladstone and Dale's law. The range of temperature was, however, comparatively small, and his results for air do not agree with those of Lorenz, von Lange, and Benoît. In fact these four observers disagree. Lorenz and Benoît found a coefficient agreeing with the above law, while von Lange obtained a coefficient less than the theoretical value.

A repetition of the measurements therefore seemed desirable. The gases examined were air, hydrogen, carbon dioxide, ammonia, and sulphur dioxide. The range of temperature was from 10° C. to